MULTIMEDIA UNIVERSITY

STUDENT IDENTIFICATION NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2018/2019

BOM2064 – QUALITY AND OPERATIONS MANAGEMENT

(All Sections / Groups)

30 MAY 2019
9:00 AM – 11:00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 8 pages with **FOUR** (4) questions only. Relevant equations and normal distribution tables are provided in the Appendix.
2. Answer **ALL** questions. The distribution of the marks for each question is given at the end of each question.
3. Please write all your answers in the answer booklet provided.

QUESTION 1

a) Healthcare services such as hospitals focus predominantly on providing services whereas automobile manufacturing produces goods. Using hospitals and automobile manufacturing as references, explain any **FIVE (5)** differences between goods and services.

(15 marks)

b) A wallpaper company produced 2,000 rolls of wallpaper in a day. Standard price for the wallpaper is RM 1 per roll. There are 5 workers, each of them working 8-hour shift per day and the labor cost is RM 5 per hour. Material cost is RM 50, and overhead is 2 times labor cost. Determine the multifactor productivity.

(**Note:** Write your answers in nearest **TWO** decimal points)

(3 marks)

c) Jamal Abdin is CEO of Abdin Manufacturing, a producer of Go-Kart tires. Abdin makes 2000 tires per day with the following resources:

Labor:	400 hours @ RM 10 per hour
Raw material:	30,000 pounds per day @ RM 1 per pound
Energy:	RM 5,000 per day
Capital:	RM 10,000 per day

(**Note:** Write your answers in nearest **THREE** decimal points)

i) What is the labor productivity for these tires at Abdin Manufacturing?

(2 marks)

ii) What is the multifactor productivity for these tires at Abdin Manufacturing?

(2 marks)

iii) What is the percent change in multifactor productivity if Abdin can reduce the energy bill by RM 2000 without cutting production or changing any other inputs?

(3 marks)

(Total: 25 marks)

Continued...

QUESTION 2

a) Arnold is a second hand car dealer and he has 10 cars for sale. He decides to investigate the relationship between the age of the used cars and the mileage of cars. The data collected from the used cars are shown in the table below:

Age (years)	Mileage (thousands of miles)
2	22
2.5	34
3	33
4	37
4.5	40
4.5	45
5	49
3	30
6	58
6.5	58

(**Note**: Write your answers in nearest **TWO** decimal points)

i) Determine the linear regression equation for the data above.

(10 marks)

ii) Calculate the correlation coefficient. Explain the relationship between the variables.

(3 marks)

iii) Forecast the mileage of the used car if the age of the used car is 7 years.

(2 marks)

b) Determine **FIVE (5)** reasons for Apple's iPhone product redesign.

(10 marks)

(Total: 25 marks)

Continued...

QUESTION 3

a) Ahmad had just purchased a new Proton X70 for his wife as a birthday present. Explain the **FIVE (5)** dimensions of product quality which Ahmad can use to evaluate his new car.

(10 marks)

b) Identify the **TWO (2)** types of variations that can be present in the output of a process. Provide examples to support your answers.

(6 marks)

c) Planet Café uses statistical process control to ensure that it's vegan sandwich loaves have the proper weight. Over the past few days, they have randomly selected and weighed six loaves and recorded the mean and range for each sample, which is given in the table below. Note that every sample consists of six loaves.

Sample	**Sample Average**	**Sample Range**
1	4.00	0.41
2	4.16	0.55
3	3.99	0.44
4	4.00	0.48
5	4.17	0.56
6	3.93	0.62

(**Note**: Write your answers in nearest **TWO** decimal points)

Calculate the control limits for both mean and range for this process.

(9 marks)

(Total: 25 marks)

Continued...

QUESTION 4

a) Nestle S.A. is a Swiss multinational food and drink company and it's the largest food company in the world. Relate **FIVE (5)** challenges that Nestle faces as a global supply chain operator.

(10 marks)

b) The weekly demand for a stereo system at Maju Electronics Co. is normally distributed, with an average of 21 per week and a standard deviation of 3 units. The lead time for receiving a shipment of new stereos is 10 days and is fairly constant. The store is open seven days a week. The manager of the store desires a service level of 90 percent.

(**Note**: Write your answers in nearest **TWO** decimal points)

i) Determine the reorder point for Maju Electronics.

(4 marks)

ii) Calculate the amount of safety stock that is appropriate for the store.

(2 marks)

iii) What is the percentage of stockout risk if the store decided not to have any safety stock?

(1 mark)

c) Explain the **FOUR (4)** elements of product design that make up the building blocks of a JIT system.

(8 marks)

(Total: 25 marks)

Continued...

RELEVANT EQUATIONS

1) CL = $\overline{\overline{X}}$, $\overline{R}$

UCL, LCL (X – bar) = $\overline{\overline{X}} \pm A_2 \overline{R}$

UCL (R) = $D_4 \overline{R}$

LCL (R) = $D_3 \overline{R}$

Table for X – bar & R Charts

No of Observation In sub group n	A2	D3	D4
2	1.88	0	3.27
3	1.02	0	2.57
4	0.73	0	2.28
5	0.58	0	2.11
6	0.48	0	2

2) UCL c = $\overline{c} + 3\sqrt{\overline{c}}$

LCL c = $\overline{c} - 3\sqrt{\overline{c}}$

3) $\overline{p}$ = Total No of Defective from All Samples/ (No of Samples X Sample Size)

$Sp = \sqrt{[\overline{p}(1 - \overline{p})/n]}$

CL = $\overline{p}$

LCL = $\overline{p} - 3\,Sp$

UCL = $\overline{p} + 3\,Sp$

4) Capacity Utilization = Capacity Used / Best Operating Level

5) $$r = \frac{n\sum XY - [\sum X \sum Y]}{\sqrt{\left[n\sum X^2 - (\sum X)^2\right]\left[n\sum Y^2 - (\sum Y)^2\right]}}$$

$$a = \overline{Y} - b\overline{X}$$

$$b = \frac{n\sum XY - \sum X \sum Y}{n\sum X^2 - (\sum X)^2}$$

6) Exponential smoothing

Forecast for the month t: $F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$

Continued...

7) Inventory Management:

$$\text{EOQ} = Q^* = \sqrt{\frac{2DS}{H}} \qquad TC = \frac{Q}{2}H + \frac{D}{Q}S$$

$$\text{EPQ} = Q_0 = \sqrt{\frac{2DS}{H}}\sqrt{\frac{p}{p-u}} \qquad I_{\max} = \frac{Q}{P}(p-u) \qquad TC = \frac{\mathrm{I}_{\max}}{2}\mathrm{H} + \frac{\mathrm{D}}{\mathrm{Q}}\mathrm{S}$$

$$SS = z\,(\sigma \mathrm{d})\sqrt{LT} \qquad ROP = \bar{\mathrm{d}}\,(LT) + z(\sigma \mathrm{d})\sqrt{LT}$$

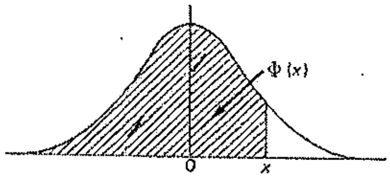
8) Lean Operations:

$$N = \frac{DT(1+X)}{C}$$

Continued...

TABLE 4. THE NORMAL DISTRIBUTION FUNCTION

The function tabulated is $\Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{1}{2}t^2}\,dt$. $\Phi(x)$ is the probability that a random variable, normally distributed with zero mean and unit variance, will be less than or equal to x. When $x < 0$ use $\Phi(x) = 1 - \Phi(-x)$, as the normal distribution with zero mean and unit variance is symmetric about zero.



x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
0·00	0·5000	0·40	0·6554	0·80	0·7881	1·20	0·8849	1·60	0·9452	2·00	0·97725
·01	·5040	·41	·6591	·81	·7910	·21	·8869	·61	·9463	·01	·97778
·02	·5080	·42	·6628	·82	·7939	·22	·8888	·62	·9474	·02	·97831
·03	·5120	·43	·6664	·83	·7967	·23	·8907	·63	·9484	·03	·97882
·04	·5160	·44	·6700	·84	·7995	·24	·8925	·64	·9495	·04	·97932
0·05	0·5199	0·45	0·6736	0·85	0·8023	1·25	0·8944	1·65	0·9505	2·05	0·97982
·06	·5239	·46	·6772	·86	·8051	·26	·8962	·66	·9515	·06	·98030
·07	·5279	·47	·6808	·87	·8078	·27	·8980	·67	·9525	·07	·98077
·08	·5319	·48	·6844	·88	·8106	·28	·8997	·68	·9535	·08	·98124
·09	·5359	·49	·6879	·89	·8133	·29	·9015	·69	·9545	·09	·98169
0·10	0·5398	0·50	0·6915	0·90	0·8159	1·30	0·9032	1·70	0·9554	2·10	0·98214
·11	·5438	·51	·6950	·91	·8186	·31	·9049	·71	·9564	·11	·98257
·12	·5478	·52	·6985	·92	·8212	·32	·9066	·72	·9573	·12	·98300
·13	·5517	·53	·7019	·93	·8238	·33	·9082	·73	·9582	·13	·98341
·14	·5557	·54	·7054	·94	·8264	·34	·9099	·74	·9591	·14	·98382
0·15	0·5596	0·55	0·7088	0·95	0·8289	1·35	0·9115	1·75	0·9599	2·15	0·98422
·16	·5636	·56	·7123	·96	·8315	·36	·9131	·76	·9608	·16	·98461
·17	·5675	·57	·7157	·97	·8340	·37	·9147	·77	·9616	·17	·98500
·18	·5714	·58	·7190	·98	·8365	·38	·9162	·78	·9625	·18	·98537
·19	·5753	·59	·7224	·99	·8389	·39	·9177	·79	·9633	·19	·98574
0·20	0·5793	0·60	0·7257	1·00	0·8413	1·40	0·9192	1·80	0·9641	2·20	0·98610
·21	·5832	·61	·7291	·01	·8438	·41	·9207	·81	·9649	·21	·98645
·22	·5871	·62	·7324	·02	·8461	·42	·9222	·82	·9656	·22	·98679
·23	·5910	·63	·7357	·03	·8485	·43	·9236	·83	·9664	·23	·98713
·24	·5948	·64	·7389	·04	·8508	·44	·9251	·84	·9671	·24	·98745
0·25	0·5987	0·65	0·7422	1·05	0·8531	1·45	0·9265	1·85	0·9678	2·25	0·98778
·26	·6026	·66	·7454	·06	·8554	·46	·9279	·86	·9686	·26	·98809
·27	·6064	·67	·7486	·07	·8577	·47	·9292	·87	·9693	·27	·98840
·28	·6103	·68	·7517	·08	·8599	·48	·9306	·88	·9699	·28	·98870
·29	·6141	·69	·7549	·09	·8621	·49	·9319	·89	·9706	·29	·98899
0·30	0·6179	0·70	0·7580	1·10	0·8643	1·50	0·9332	1·90	0·9713	2·30	0·98928
·31	·6217	·71	·7611	·11	·8665	·51	·9345	·91	·9719	·31	·98956
·32	·6255	·72	·7642	·12	·8686	·52	·9357	·92	·9726	·32	·98983
·33	·6293	·73	·7673	·13	·8708	·53	·9370	·93	·9732	·33	·99010
·34	·6331	·74	·7704	·14	·8729	·54	·9382	·94	·9738	·34	·99036
0·35	0·6368	0·75	0·7734	1·15	0·8749	1·55	0·9394	1·95	0·9744	2·35	0·99061
·36	·6406	·76	·7764	·16	·8770	·56	·9406	·96	·9750	·36	·99086
·37	·6443	·77	·7794	·17	·8790	·57	·9418	·97	·9756	·37	·99111
·38	·6480	·78	·7823	·18	·8810	·58	·9429	·98	·9761	·38	·99134
·39	·6517	·79	·7852	·19	·8830	·59	·9441	·99	·9767	·39	·99158
0·40	0·6554	0·80	0·7881	1·20	0·8849	1·60	0·9452	2·00	0·9772	2·40	0·99180

34

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TABLE 4. THE NORMAL DISTRIBUTION FUNCTION

x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
2·40	0·99180	2·55	0·99461	2·70	0·99653	2·85	0·99781	3·00	0·99865	3·15	0·99918
·41	·99202	·56	·99477	·71	·99664	·86	·99788	·01	·99869	·16	·99921
·42	·99224	·57	·99492	·72	·99674	·87	·99795	·02	·99874	·17	·99924
·43	·99245	·58	·99506	·73	·99683	·88	·99801	·03	·99878	·18	·99926
·44	·99266	·59	·99520	·74	·99693	·89	·99807	·04	·99882	·19	·99929
2·45	0·99286	2·60	0·99534	2·75	0·99702	2·90	0·99813	3·05	0·99886	3·20	0·99931
·46	·99305	·61	·99547	·76	·99711	·91	·99819	·06	·99889	·21	·99934
·47	·99324	·62	·99560	·77	·99720	·92	·99825	·07	·99893	·22	·99936
·48	·99343	·63	·99573	·78	·99728	·93	·99831	·08	·99896	·23	·99938
·49	·99361	·64	·99585	·79	·99736	·94	·99836	·09	·99900	·24	·99940
2·50	0·99379	2·65	0·99598	2·80	0·99744	2·95	0·99841	3·10	0·99903	3·25	0·99942
·51	·99396	·66	·99609	·81	·99752	·96	·99846	·11	·99906	·26	·99944
·52	·99413	·67	·99621	·82	·99760	·97	·99851	·12	·99910	·27	·99946
·53	·99430	·68	·99632	·83	·99767	·98	·99856	·13	·99913	·28	·99948
·54	·99446	·69	·99643	·84	·99774	·99	·99861	·14	·99916	·29	·99950
2·55	0·99461	2·70	0·99653	2·85	0·99781	3·00	0·99865	3·15	0·99918	3·30	0·99952

The critical table below gives on the left the range of values of x for which $\Phi(x)$ takes the value on the right, correct to the last figure given; in critical cases, take the upper of the two values of $\Phi(x)$ indicated.

x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$	x	$\Phi(x)$
			0·9994		0·99990		
3·075		3·263		3·731		3·916	
	0·9990		0·9995		0·99991		0·99995
3·105		3·320		3·759		3·976	
	0·9991		0·9996		0·99992		0·99996
3·138		3·389		3·791		4·055	
	0·9992		0·9997		0·99993		0·99997
3·174		3·480		3·826		4·173	
	0·9993		0·9998		0·99994		0·99998
3·215		3·615		3·867		4·417	
	0·9994		0·9999		0·99995		0·99999
							1·00000

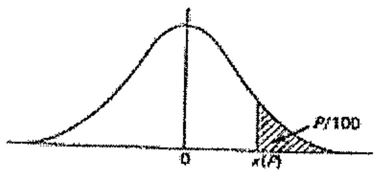
When $x > 3·3$ the formula $1-\Phi(x) \doteq \frac{e^{-\frac{1}{2}x^2}}{x\sqrt{2\pi}}\left[1-\frac{1}{x^2}+\frac{3}{x^4}-\frac{15}{x^6}+\frac{105}{x^8}\right]$ is very accurate, with relative error less than $945/x^{10}$.

TABLE 5. PERCENTAGE POINTS OF THE NORMAL DISTRIBUTION

This table gives percentage points $x(P)$ defined by the equation

$$\frac{P}{100} = \frac{1}{\sqrt{2\pi}}\int_{x(P)}^{\infty} e^{-\frac{1}{2}t^2}\,dt.$$

If X is a variable, normally distributed with zero mean and unit variance, $P/100$ is the probability that $X \geqslant x(P)$. The lower P per cent points are given by symmetry as $-x(P)$, and the probability that $|X| \geqslant x(P)$ is $2P/100$.



P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$	P	$x(P)$
50	0·0000	5·0	1·6449	3·0	1·8808	2·0	2·0537	1·0	2·3263	0·10	3·0902
45	0·1257	4·8	1·6646	2·9	1·8957	1·9	2·0749	0·9	2·3656	0·09	3·1214
40	0·2533	4·6	1·6849	2·8	1·9110	1·8	2·0969	0·8	2·4089	0·08	3·1559
35	0·3853	4·4	1·7060	2·7	1·9268	1·7	2·1201	0·7	2·4573	0·07	3·1947
30	0·5244	4·2	1·7279	2·6	1·9431	1·6	2·1444	0·6	2·5121	0·06	3·2389
25	0·6745	4·0	1·7507	2·5	1·9600	1·5	2·1701	0·5	2·5758	0·05	3·2905
20	0·8416	3·8	1·7744	2·4	1·9774	1·4	2·1973	0·4	2·6521	0·01	3·7190
15	1·0364	3·6	1·7991	2·3	1·9954	1·3	2·2262	0·3	2·7478	0·005	3·8906
10	1·2816	3·4	1·8250	2·2	2·0141	1·2	2·2571	0·2	2·8782	0·001	4·2649
5	1·6449	3·2	1·8522	2·1	2·0335	1·1	2·2904	0·1	3·0902	0·0005	4·4172

35

End of Page